Development of a VME data acquisition system

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The increasing interest in nuclear fragmentation measurements, both for ion therapy and space radiation protection applications, demands a large amount of data takings often performed in various facilities around the world. In order to minimize the discrepancies between different data acquisition systems (DAQ), e.g. charge and time resolution, maximum acquisition rate, dead time efficiency and so on, a portable DAQ system, based on standard VME bus and developed at "Scienze di Base e Applicate per l'Ingegneria" (SBAI) Department of "Sapienza" University of Rome, has been successfully installed and operated. In contrast to the Multi Branch System (MBS) [1] currently used at GSI, this system is more suitable for small-scale experiments, i.e. where few detectors are involved and hence few channels need to be read out. The software can run on any Linux platform, hence maximizing its portability, and currently supports two different boards that can be alternatively used as crate controller: a 2.0 USB link bridge (CAEN V1718) and an optical link bridge (CAEN V2718). The former allows to use as DAQ PC even a laptop (with a maximum acquisition rate, limited by USB data transfer rate), while the latter requires only one standard PCI slot for the optical link card (with a maximum acquisition rate of $\sim$20 kHz). This new system has been successfully used during GSI fall beam-time [2], [3] showing promising results.

DAQ setup

In the last decades, the VME bus has proved to be a reliable and versatile tool for data acquisition systems in experimental physics. Moreover, the availability of *bridge boards*, that allow a simple and quite fast VME bus readout, has increased the interest in this standard. For this reason, a portable DAQ system relying on VME bus has been installed and successfully operated at GSI. This system, formerly developed by A. Sarti and V. Patera at "Scienze di Base e Applicate per l'Ingegneria" (SBAI) Department of "Sapienza" University of Rome, has been built in order to guarantee a high modularity (including or excluding a board is, in fact, a straightforward process). Furthermore, the software includes a built-in decoding tool that converts acquired data (standard binary files) directly in a ROOT file.

The core of the DAQ is the bridge board that has been programmed to work simoultaneously as crate controller and I/O register. The system supports both USB (CAEN V1718) and optical link (CAEN V2718) bridge boards. In the former case even a laptop can be used as DAQ PC (with a maximum allowed transfer rate limited by USB port $\sim$1 kHz) while the latter requires only a PCI slot to be accessed. The acquisition and the decoding software has been written in standard C/C++ language in order to enhance its customization capabilities. The system already supports several commercial VME boards (mostly CAEN TDC, QDC, ADC, Scaler) and has been tested and used in a "minimal" and in a "typical" configuration to benchmark its performances. In order to prevent multiple trigger events, a dedicated dead-time logic has been implemented too.

A first test has been performed with a NIM pulsed signal (100 kHz) used as trigger and only the bridge (CAEN V2718) and a QDC (CAEN V792N) have been acquired. In this basic configuration, a rate of $\sim$ 20 kHz has been reached, hence defining the acquisition rate upper limit. The "typical" configuration comprised the bridge (CAEN V2718), two QDCs (CAEN V792N), one peak sensing ADC (CAEN V785N) and a scaler (CAEN V560) resulting in an acquisition rate of $\sim$ 10 kHz.

In the experiments performed at GSI in the fall 2012, this latter setup was used to measure the shielding properties of different materials for astronauts protection in outer space (in the framework of ROSSINI project [2],[3]) showing very promising results.

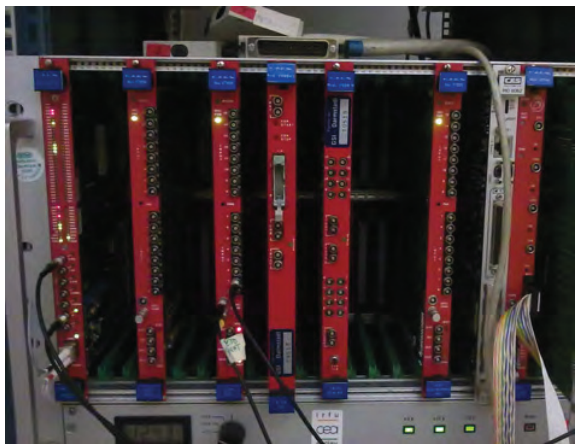

Figure 1: The DAQ system used during a calibration measurement.

References

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